

*Jurnal Mekanikal, Jilid I, 1998*

## **MARINE TECHNOLOGY EDUCATION FOR THE CHANGING MALAYSIA – THE ROLE OF MARINE TECHNOLOGY LABORATORY AT UNIVERSITI TEKNOLOGI MALAYSIA**

Mohd Zamani Ahmad

Mohd Afifi Abdul Mukti

Department of Marine Technology

Faculty of Mechanical Engineering

Universiti Teknologi Malaysia

### **ABSTRACT**

*Malaysia is changing fast towards becoming a nation that possesses comparative economic and industrial advantage base on engineering talent. Central planning includes improving its education and research programmes. The development of the Marine Technology Laboratory at Universiti Teknologi Malaysia is part of such programme to support the national maritime engineering sector. The paper captures the dynamic change of the marine technology education curricula since its inception in the early eighties and the role of the laboratory in harnessing the curricula to make it more relevant, attractive and connected.*

### **1.0 INTRODUCTION**

Boyles C. et al [1] identifies science and technology revolutions that have changed the world, namely Revolution of the Seventeenth Century, the Industrial Revolution

of the Eighteen Century and the Emergence of the 'Big' Science and Technology. The Green Report [2] quoting Richard Morrow, the past chairman of the United States National Academy of Engineering recognises it and claims that it is now leading to the era of Competitive Technology. It emphasises that 'the world is relying increasingly on technology for economic growth and job development...(by)...focusing a significant amount of its technology investment from national security to international economic competitiveness'. It also hypothesises that 'the nation with the best engineering talent is in possession of the core ingredient of comparative economic and industrial advantage' and finally confirms that the society at large is turning itself into a technology-dependent society of the twenty-first century.

Responding to the Green Report's suggestion that engineering education must change to meet the new challenges, the United States Joint Task Force on Engineering Education Assessment [3] confirms few important criteria of future engineering curricula. It came to the conclusion that the world's future engineering education programs must not only teach the fundamentals of engineering theory, experimentation and practice, but be relevant, attractive and connected. In defining the three keywords the Green Report specifies that future engineering education programs should:

- i. be relevant to the lives and careers of students, preparing them for a broad range of careers as well as lifelong learning involving both formal and hands-on experience,
- ii. be attractive so that the excitement and intellectual content will attract highly talented students with a wider variety of backgrounds and career interests,
- iii. be connected to the needs and issues of the broader community through integrated activities with other parts of the educational system, industry and government.

## **2.0 THE CHANGING MALAYSIA**

Malaysia is fully aware of the importance of science and technology to its national economy. The Industrial Master Plan [4] formulated in the mid eighties serves as a prove that Malaysia has the vision to take industrialisation as its main economic drive. The national planning towards such goal is further enhanced through its VISION 2020 programmes. Infected its implementation is taking full advantage of the fast advancing technology especially in the manufacturing sector. Within the same context one of its aims is to establish a scientific, progressive, innovative and forward looking nation contributing to the scientific and technological civilisation of the future [5]. Sharing this view with its regional counterparts through ASEAN the joint regional goals on science and technology has been set at [6];

- i. encouraging technological competitiveness by regional cooperation in science and technology
- ii. developing human resources in science and technology
- iii. upgrading human resources by building institutional capacity for education, training and research, science and technology and technology transfer.

Until the nineties Malaysia has evidently focused its efforts on technology through enhancing its research and development mechanism. This includes recruitment of expatriate researchers, establishing more research institutions and offering direct incentives to industries engaging in research and development activities [7].

The phase of change for Malaysia will end when its Multimedia Super Corridor programmes are completed. Malaysia would then be fully wired, so to say, and should thus be 'in possession of the core ingredient of comparative economic and industrial advantage' [2].

### **3.0 MARINE TECHNOLOGY EDUCATION AT UNIVERSITI TEKNOLOGI MALAYSIA (UTM)**

The diploma and degree Marine Technology programmes at UTM started in 1981. The courses have been introduced to cater the local needs for engineers and skilled personnel to serve the Malaysian maritime industries. It has been the only local university that bridges the gap between the pool of graduates from local maritime academy and polytechnic and those graduated from foreign universities.

Although conventional in its design, the courses' curricula aim to produce generalist engineers as suggested by few writers such as Masood [8] and Ajmal [9]. It is thus a mix of three areas of study namely marine engineering, naval architecture and maritime studies. The courses are relevant in the sense that they are industry demanded and they are also connected since students are sent for industrial training at various maritime related industries around the country.

The contents of the courses have been adjusted many times much to the requirement of the changing technology experienced by the industry. The first change is came together with the Computer Aided Design (CAD) era of the early eighties. It has forced the university to review the ship design syllabuses to enrich them with knowledge on CAD techniques especially for the ship design studio works. Studio works later incorporate practical CAD works.

The implementation of the Industrial Master Plan around the middle of the eighties has triggered the second marked change. This second force of change is also coupled with the effort by the university to obtain full international recognition on the Marine Technology course being conducted. Prior to that the course has inherited the problem of low relevancy of experimental works due to lack of proper laboratory equipment. Effort was later intensified on the building up of laboratory equipment relevant to the study of naval architecture. This includes the design and fabrication of a 1.5m x 2.0m x 12.0m steel water tank with ship model towing facilities for model of approximately 1.0m.

The national goal of turning local universities into centers of excellence has finally brought the climax change to the course. The central agencies finally approved the multi million ringgit project on the development of a marine technology laboratory at UTM. The approval came timely with the university's goal of becoming a discovery university. The laboratory has drastically improved the quality of engineering practices for the course.

Meanwhile the 10 % students' contact hours for industrial training [10] with the relevant industry has also been improved to more than double the figure. Students are at present required to complete a 6 months one-shot full semester industrial attachment. For this closely monitored attachment, the student will be awarded 12 credit hours.

#### **4.0 FUNCTION OF THE MARINE TECHNOLOGY LABORATORY**

In response to the Industrial Master Plan released in the early 80s UTM started to prepare its proposal for a laboratory that will directly support the local shipbuilding industry. The proposal was submitted in 1987 and approved for implementation in 1989.

The project cost is approximately RM35 millions. The project is managed in-house and equipment selection, design and commissioning was handled by academic staffs. The contract was awarded in 1994 to a company working closely with the much known and respectful Marine Research Institute Netherlands (MARIN) and was finally commissioned in 1996.

The laboratory is aimed at fulfilling three missions; to provide better educational facilities for graduate and undergraduate students, to embark into advance research in marine hydrodynamic and thirdly to engage itself in research and development requirement from the industry. The laboratory time has therefore been split into 30:70 portions; 30% being for students experimental works while 70% is assigned for research works for the university as well as the industry.

The prime function of the laboratory is centered around model tests on ships. In a layman term, such tests are performed in a long water tank (the towing tank) and includes those on determining power requirement for the ships as well as determining the behavior of ships under the influence of waves while at sea (in a non-layman term the types of test can be further broken down and 'ship' should include its similar kind such as submarines and offshore structures). Activities at the laboratory therefore center on this function. The main activities are ship design, model fabrication, model instrumentation, towing tank tests and data collection and analysis. Additional activities carried out at the laboratory include computer assisted ship calculation works (such as estimation and verification of propulsive efficiency), organising seminars, conferences and short courses and of course experimental works for under graduate students.

## 5.0 THE LABORATORY FACILITIES

The laboratory is housed within a two stories L-shaped building and can be effectively sectioned into 4 main sections; the towing tank area, the workshop areas, the data processing and analysis area and the administration area.

Figures 1 and 2 provides summarised technical features of the facilities at the laboratory.

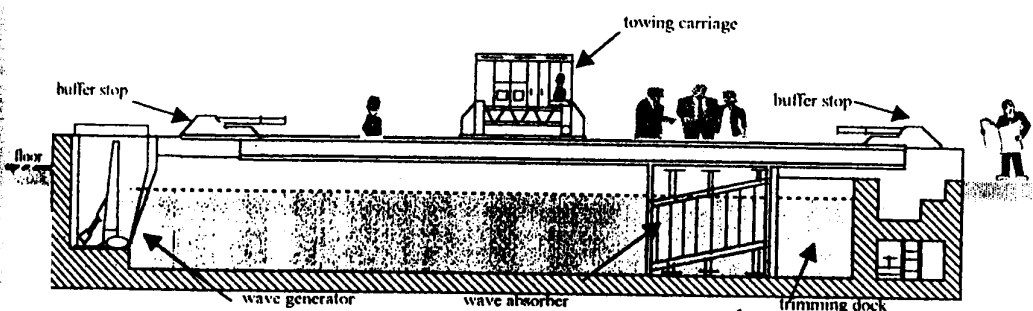


Fig. 1 Cross Section View of the Towing Tank

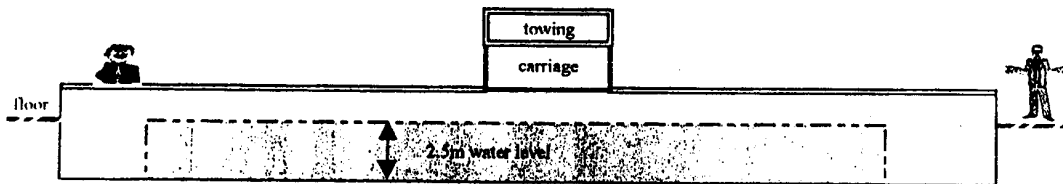


Fig. 2 Front Elevation of the Towing Tank

### 5.1 Towing Tank

The towing tank is 128m long, 4m wide and 3m deep with 2.5m water depth. It is equipped with a towing carriage, a data acquisition and analysing system, a wave generator, a wave absorber and a trimming dock. The towing carriage is capable of running at a speed of  $0$  to  $5\text{ms}^{-1}$  with a speed holding accuracy and stability of  $0.1\%$ FSR. The data acquisition and analysing system is installed on the carriage and is capable of performing pre-processing up to the stage of obtaining performance data such as speed, forces and moment.

The wave generator is capable of generating regular and irregular waves. In summary the important specifications [11] for the regular waves are for tank's wave heights of up to  $0.44\text{m}$ , wave period of  $0.5$  to  $2.5\text{s}$  while those the irregular waves are for significant wave height of  $0.25\text{m}$  and a period of  $0.5 - 1.7\text{s}$ . For the regular waves the wave height accuracy is  $10\%$  FSR while period accuracy is  $2\%$  of the required value. For the random waves the wave height accuracy is  $5\%$  FSR while the spectrum accuracy is  $5\%$  FSR.

The wave absorber is of perforated expanded metal construction and  $95\%$  efficient. A trimming dock of  $4 \times 2\text{m}$  is situated behind the wave absorber to

facilitate ship model trimming and installation to the towing carriage prior to towing tank test.

## **5.2 The Workshop Facilities**

The workshop facilities support the need for model making, mechanical fabrication, electronic and instrumentation and materials and spare parts storage. The model making facilities are suitable for wood and fiberglass works and the ship model-milling machine is of semi-auto type. The mechanical workshop support the needs to fabricate test rigs of steel (or other materials) constructions such as offshore platforms.

The instrumentation workshop is equipped with facilities for electronic and instrument's calibration works. The main equipment for calibration works is the universal primary calibrator for the calibration of force transducers. Materials and spare parts storage takes one quarter of the total workshop area.

## **5.3 Data Processing and Research Area**

Data processing for ship model test is normally done in two stages. The first level data processing, or better known as the on-line pre processing, is done on the towing carriage itself using the Data Acquisition and Analysing System. The time consuming second stage of off-line The data processing and analysis area occupies most of the 2<sup>nd</sup> level. Apart from the computers for off-line analysis and the server system linking the laboratory to the rest of similar institutions around the world, the area are shared by research assistants and research officers working with projects related to the laboratory. The final analysis on the data including statistical and harmonic analysis is carried out in this area.



## 6.0 TEST TYPES AND TEST EQUIPMENT

The type of tests that can be performed at the laboratory is numerous. To put it in a more readily understandable format it can be structured in a summarised matrix form as presented in Tables 1 and 2.

Table 1 Test Matrix

MODEL TEST		
	Primary test	Secondary test
Ship model	Powering	1.Resist.test 2.Propuln. test
	Hull efficiency	1.wake analysis 2.flow viscosity
	Motion	1.Seakeeping 2.Hydrodynamic coefficient
Submerged model	Powering	(as above)
	Hull efficiency	(as above)
	Motion	(as above)
Offshore model	Installation simulation	
	Wave load	
	Etc.	

Table 2 Test matrix

OTHER TESTS		
	Primary test	Secondary test
Sea Trial	Motion	1.Motion. monitoring
Computer simulation test	Powering	1.Resist.test 2.Propuln. test
	Motion	1.Seakeeping

The tables are not complete but it is evident that testing works at the laboratory can be divided into the model test and non-model tests. Model tests can be for any of the three main categories namely ship model, submerged model and offshore models. Each of these categories has two classifications of tests; the primary test and the secondary tests. It shows that the three primary tests for ship model are hull efficiency, investigation on propulsion requirement and studies on ship motion. Each primary test can be broken down into few secondary tests. For example the two most common for investigation on propulsion requirement are the resistance test and the self-propulsion test while wake studies at ship's stern can be included under the hull efficiency classification. To take another example one of the secondary tests for motion behavior under submerged model can include model test on the installation of offshore underwater cables.

The mix on test equipment for the laboratory has been made along that line of thought. Therefore the test equipment at the laboratory is made up of a combination of main equipment as well as secondary testing equipment. There are six main test equipment, namely resistance and movement dynamometer, self-propulsion system, wake measurement apparatus, planar motion mechanism, wake measurement apparatus and 6-component force measurement system. The main test equipment is supported with secondary equipment such as wave height meters, accelerometers and force and pressure transducers.

It is worth mentioning that the performance specification for each of the equipment has been selected such that its capability is in accordance with the requirement set forth by international standards on ship model testing. Its individual contribution to the total laboratory system should also produce test results comparable to those produced by other similar institutions in other part of the world. Critical specification such as linearity, sensitivity, stability and accuracy of equipment has been strictly maintained at a very high standard.

## **7.0 WORK EXPERIENCE AND FUTURE**

The laboratory has been in operation for two full years since its commissioning date on September 1996. For the first year the laboratory has been busy with post commissioning training under the experts from MARIN. The training was aimed at giving further guidance on matters relating to test procedures and data interpretation. The training programme has been enriched with contents aimed at validating the tank with test results obtained from similar test on the same model carried out at MARIN.

To this date the laboratory has engaged itself on six ship model testing, one ship-motion-monitoring sea trial, one offshore structure test, two short courses and few other research projects. The ship model tests include resistance tests, propulsion tests, sea-keeping tests and wave load tests. Considering that the laboratory has just started and the fact that it is also influenced by the bad economic down turn that is affecting the local shipbuilding industry its record so far is quite respectable.

With the recent joint cooperative effort among the ASEAN nations the future opportunities in the local shipbuilding industry will likely to prosper. There has been positive indication that some government related shipbuilding programmes are proceeding despite the economic downturn. To cater for this expected demand some expansion programme has been drawn for the laboratory. The laboratory shall in future be equipped with facilities to perform the complete series of ship motion simulation tests and also a cavitation tunnel to complete the ship propulsion test series. Recent development in the computing technology has produced better results

on hydrodynamics tests by computer simulation. The laboratory shall be expanded with such development in mind.

As of August 1998 the Marine Technology Laboratory was accepted as a member of the International Towing Tank Committee (ITTC). Membership to ITTC adds another honour to UTM as UTM is now a member of the international community of Towing Tank operators. By sharing problems and ideas with other operators data generated from UTM's laboratory will be further verified.

## **8.0 CONCLUSION**

Malaysia has positively responded to the newly proposed hypothesis that competitive technology will be the future equation of comparative economic advantage. Engineering education programmes for Malaysia has also been revised to prepare itself for the future. The Marine Technology Laboratory is aimed at producing better marine technologists for Malaysia.

## **REFERENCES**

1. Charles, B., Peter, W., and Brian Sturges, People, Science and Technology, A Guide to Advanced Industrial Society, Harvester Press, 1984, 13-21
2. The Green Report – Engineering Education for a Changing World, National Engineering Information Center, <http://www.asee.org/pubs2/html/greenworld.htm>, 9<sup>th</sup> November 1998.
3. Assessment White Paper – A Framework for the Assessment of Engineering Education, National Engineering Information Center, <http://www.asee.org/pubs2/html/assessment.htm>, 22<sup>nd</sup> June 1996.
4. Executive Highlights, Medium and Long Term Industrial Master Plan Malaysia 1986-1995, UNDP/UNIDO/DP/MAL/79/001, August 1985

5. Hanizah Abdul Hamid, (et. al.), Vision 2020: Continuing Post Graduate Engineering Education, IT~MN's Role, Conference on Engineering Education, Meeting the Industrial Challenge Beyond 2000, 12-13 Dec. 1993, Kuala Lumpur
6. Towards a Framework for Future ASEAN-UNDP Collaboration, Draft Version 1, Joint Issues Paper for UNDP-ASEAN, Mid-Term Review of ASP-5, Volume II, 3<sup>rd</sup> September 1996, <http://www.undp.org:81/undp/rbap/program/asean2.htm>
7. Chapter 3, Incentives for Investment, <http://www.jaring.my/mida/policy/chapter3text.html#3> 10, pp.9-10, 31<sup>st</sup> August 1998.
8. Masood, S.,H, (et. al), Rationalisation of Mechanical Engineering Course – Introducing New Technology, Journal of Engineering Education In Southeast Asia, Vol.17, No.1, 1987
9. Ajmal, I.,A., Engineering Education – Neglected Aspects, Conference on Engineering Education, Meeting the Challenge Beyond 2000, 12-13 December 1993, Kuala Lumpur
10. Ahmad, M.,Z., (et.al), Mechanical Engineering Education for Vision 2020; Conference on Mechanical Engineering, PACME'95, Technological University of Philippines, 5 April 1995
11. The Design, Supply, Delivery, Installation, Testing and Commissioning of the Equipment and Materials for Marine Laboratory of Universiti Teknologi Malaysia, Skudai, Johor Malaysia, Contract Document No.UTM/JB/PK/15/94, April 1994